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Re: Endangered Species Act Listing Determination for the Pacific Walrus

We are submitting these comments to inform the upcoming Endangered Species Act listing determination for the Pacific walrus, required during fiscal year 2017. In February 2011, the Fish and Wildlife Service ("Service") determined that the Pacific walrus warrants protection under the Endangered Species Act; however, the Service precluded listing at that time. Since 2011, the primary threats to the Pacific walrus have only worsened, particularly the rapid loss of essential sea ice habitat and ocean acidification, putting the walrus in further jeopardy. The Pacific walrus clearly merits listing as a threatened or endangered species.

These comments present the best available science published since the 2011 status review on the key threats to the Pacific walrus, including (1) rapid sea ice loss and ocean acidification, driven by greenhouse gas pollution; (2) evidence of harm to the Pacific walrus resulting from anthropogenic climate change; (3) the inadequacy of existing regulatory mechanisms to reduce greenhouse gas pollution; and (4) the significant international trade in walrus ivory. We recommend that the Service update the Bayesian network model that informed the 2011 warranted determination with this new scientific information on walrus status and threats. We also review recent judicial rulings that provide essential direction for the Service's listing determination for the Pacific walrus.

These comments are submitted on behalf of the Center for Biological Diversity, a national non-profit conservation organization supported by more than 1.1 million members and online activists. The Center petitioned to protect the Pacific walrus under the Endangered Species Act in 2008, and the Center and its members have a long-standing interest in the conservation of the Pacific walrus and its habitat.

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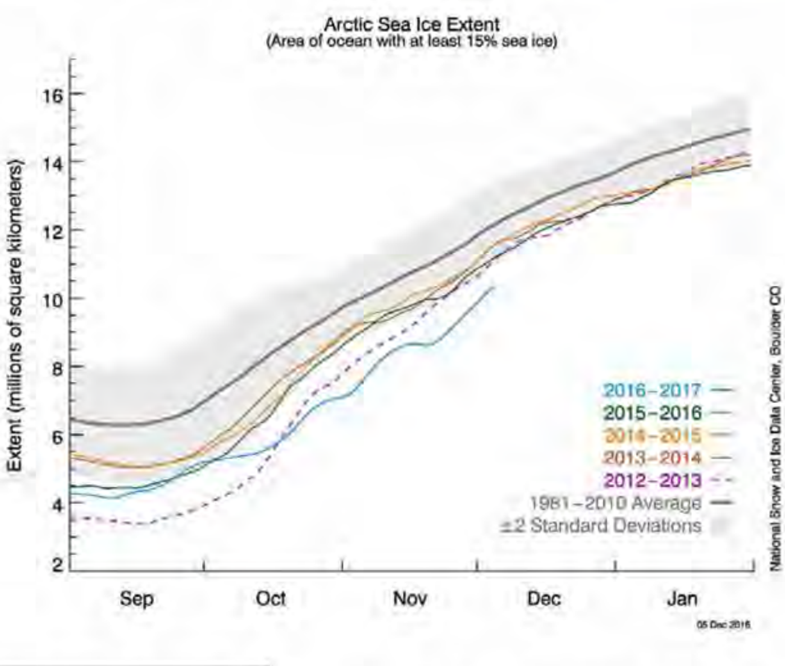
I. The Walrus Continues To Face Imminent, High-Magnitude Threats From Greenhouse Gas Pollution Driving Sea Ice Loss and Ocean Acidification

A. The continuing loss of sea ice habitat threatens the Pacific walrus

Since the warranted but precluded determination in 2011, the walrus's sea ice habitat has continued to disappear at a rapid rate as a result of global warming driven by greenhouse gas pollution.[1] As summarized in a 2014 review, Arctic sea ice "extent is decreasing, ice is thinning, multiyear ice is covering less of the Arctic Ocean, melt is occurring earlier, albedo is decreasing, and the Arctic is absorbing more energy due to this sea ice decline."[2]

As of mid-December, Arctic sea ice extent was at a record low, substantially below the previous record low in 2012. *See* Figure 1 (below). In fact, sea ice extent hit a record low during both October and November 2016, and it is continuing on a record-low trajectory for December. Sea ice extent remains especially low within the Chukchi Sea, as well as the neighboring Beaufort, East Siberian, and Kara Seas.

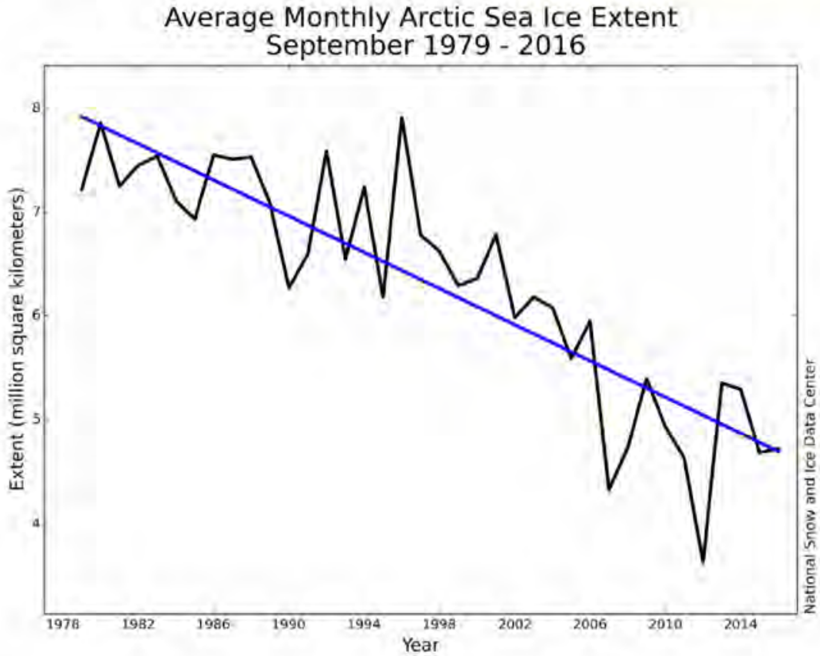
Figure 1. Arctic sea ice extent in fall 2016 compared to the prior record-low year in 2012. The figure shows daily Arctic sea ice extent as of December 5, 2016, along with daily ice extent data for four previous years. 2016 is shown in blue, 2015 in green, 2014 in orange, 2013 in brown, and 2012 in purple. The 1981 to 2010 average is in dark gray. The gray area around the average line shows the two standard deviation range of the data.
Source: National Snow and Ice Data Center: http://nsidc.org/arcticseaicenews/



[1] Meier, W.N. et al. 2014. Arctic sea ice in transformation: A review of recent observed changes and impacts on biology and human activity. Rev. Geophys 51: 185–217; Wood, K.R. et al. 2015. A decade of environmental change in the Pacific Arctic region. Progress in Oceanography 136: 12-31.
[2] Meier, W.N. et al. 2014, at 199.

Shockingly, Arctic summer sea ice extent has decreased by half during the past few decades.[3] September sea ice extent declined by an average of 13.3 percent per decade between 1979 and 2016 (*see* Figure 2),[4] and the downward September trend has accelerated over the past decade.[5] The 2016 sea ice maximum in March was the second lowest in the satellite record, and winter sea ice continues to decline at a rate of 2.7 percent per decade.[6]

Figure 2. Monthly September sea ice extent during 1979 to 2016 shows a decline of 13.3% per decade.
Source: National Snow and Ice Data Center: http://nsidc.org/arcticseaicenews/2016/10/



The sea ice season is shortening as sea ice melts earlier in spring and forms later in autumn.[7] The sea ice season (i.e., number of days with sea ice coverage) shortened at an average rate of at least 5 days per decade between 1979 and 2013,[8] with some areas of the Chukchi Sea shortening by 30 days per decade.[9]

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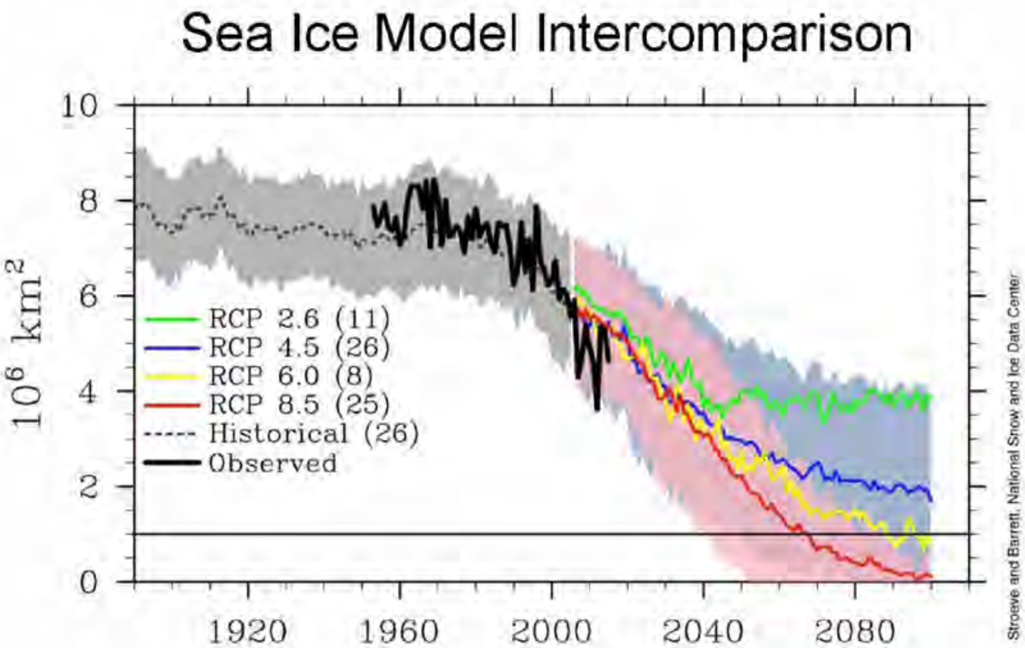
[3] Stroeve, J. et al. 2008. Arctic sea ice extent plummets in 2007. EOS Transactions, AGU 89:13-14.
[4] NSIDC [National Snow and Ice Data Center]. 2016. September 2016 Compared to Previous Years, 5 October 2016, http://nsidc.org/arcticseaicenews/2016/10/
[5] Stroeve, J.C. et al. 2014. Changes in Arctic melt season and implications for sea ice loss. Geophysical Research Letters 41: 1216-1225.
[6] NSIDC [National Snow and Ice Data Center]. 2016. March 2016 Compared To Previous Years, 6 April 2016, https://nsidc.org/arcticseaicenews/2016/04/
[7] Parkinson, C.L. 2014. Spatially mapped reductions in the length of the Arctic sea ice season, Geophysical Research Letters 41: 4316–4322.
[8] Stroeve, J.C. et al. 2014. Changes in Arctic melt season and implications for sea ice loss. Geophysical Research Letters 41: 1216-1225.
[9] Parkinson, C.L. 2014, at Figure 4.

Arctic sea ice thickness has declined by approximately 40% on average in recent decades due in large part to the loss of older, thicker ice.[10] A recent study using subsurface, aircraft, and satellite observations estimated a 34% decline in annual mean ice thickness over the Arctic Basin just during the recent period 2000-2012, and a 50% decline in September ice thickness over this period.[11] During the longer period from 1975-2012, annual mean ice thickness in the central Arctic Basin decreased by 65% overall and by 85% in September.[12] In the Chukchi Sea, a separate study estimated that sea ice thickness declined by 64% between 1958 and 2007.[13]

Arctic summer sea ice is expected to virtually disappear before mid-century, with estimates of 2020 or earlier, 2030 on average, and 2040 or later based on three modeling approaches.[14] Declines in sea ice are happening faster than climate models have projected.[15] Both IPCC AR4 models and the improved AR5 models underestimate the observed trend in September sea ice, with the underestimation becoming more pronounced in recent years.[16] For example, Figure 3 (below) shows observed sea ice extent below that projected by all RCP scenarios. Notz and Stroeve (2016) found that most CMIP5 models systematically underestimate the observed sensitivity of Arctic sea ice relative to anthropogenic CO_2 emissions.[17]

Figure 3. This figure shows projected and hindcasted September sea ice extent (colors and shading) for climate models participating in the Intergovernmental Panel on Climate Change 5th Assessment, along with observations (black line). The projections are for four scenarios of greenhouse gas concentrations for the future (starting in 2006), termed Representative Concentration Pathways (RCPs) that relate to the radiative forcing at the top of the atmosphere that could occur at the year 2100. The shading indicates the one standard deviation range in the hindcasts and projections.
Source: NSIDC, http://nsidc.org/arcticseaicenews/2015/12/a-variable-rate-of-ice-growth/

[10] Meier, W.N. et al. 2014.
[11] Lindsay, R. and A. Schweiger. 2015. Arctic sea ice thickness loss determined using subsurface, aircraft, and satellite observations. Cryosphere 9: 269-283.
[12] *Id.*
[13] Kwok, R., and D. A. Rothrock. 2009. Decline in Arctic sea ice thickness from submarine and ICESat records: 1958-2008. Geophysical Research Letters 36: L15501.
[14] Overland, J.E. and M. Wang. 2013. When will the summer Arctic be nearly sea ice free? Geophysical Research Letters 40: 2097-2101.
[15] Stroeve, J. et al. 2007. Arctic sea ice decline: Faster than forecast. Geophysical Research Letters 34: L09501.
[16] Meier, W.N. et al. 2014.
[17] Notz, D. and J. Stroeve. 2016. Observed Arctic sea ice loss directly follows anthropogenic CO_2 emission. Science 10.1126/science.aag2345.



Sea ice loss in the Chukchi Sea

The Chukchi Sea has experienced some of the fastest declines in sea ice cover in the Arctic due to climate warming.[18] Trends in the loss of sea ice cover in the Chukchi Sea have accelerated greatly over the past decade,[19] and the Chukchi Sea has experienced essentially ice-free conditions during the summer in recent years.[20] Thick multiyear sea ice older than two years has almost entirely disappeared, replaced by thin and more mobile first-year ice.[21] As the area of ice-free ocean susceptible to rapid solar heating increases, more heat is accumulated in the upper ocean in summer and persists later into the autumn freeze-up.[22] Monthly surface air temperature anomalies greater than 6°C have occurred frequently in the autumn in the Chukchi Sea.[23]

In the southern Chukchi Sea (averaged along 70°N), open-water duration by 2040 is projected to increase from a current 3 to 4 months to 5 months, based on a mean of twelve selected climate models from CMIP5 that have good historical simulation performance.[24] In the northern Chukchi Sea (80°N) where there is currently no open water, models project 1 month of open water by 2040.[25]

[18] Frey, K.E. et al. 2015. Divergent patterns of recent sea ice cover across the Bering, Chukchi and Beaufort seas of the Pacific Arctic Region. Progress in Oceanography 136: 32-49, at 33.
[19] Frey, K.E. et al. 2015, at 43.
[20] Wood, K.R. et al. 2015, at 12.
[21] *Id.*
[22] *Id.*
[23] *Id.*
[24] Wang, M. and J.E. Overland. 2015. Projected future duration of the sea ice-free season in the Alaskan Arctic. Progress in Oceanography 136: 50-59.
[25] *Id.*

Sea ice disruption in the Bering Sea

An important new study by Ray et al. (2016) documents significant changes in Bering Sea ice structure during the winter-spring season that are expected to be highly disruptive for Pacific walrus reproductive, feeding, and migratory activities.[26] Based on satellite imagery during March to May 2003 to 2013, Bering Sea ice in winter-spring has become highly variable, and has transitioned from a plastic continuum governed primarily by fracture mechanics to a "mixing bowl" of ice floes moving relatively independently. Winter-spring sea ice is breaking up and melting out earlier than historically.

Ray et al. (2016) discussed several important changes in the Bering Sea seascape: (1) southward sea ice extent has varied significantly in March for all years; (2) major melt-outs have produced large expanses of open water, dispersing floes over large areas; (3) repeated melting and freezing events have occurred as early as February, even in cold years, which has resulted in large expanses of young ice which are vulnerable to rapid melting from May onward; (4) upper ocean waters are being mixed by the advection of warmer North Pacific water and storm events, shifting ice morphology toward smaller floes; and (5) very large areas of nearly-open water have occurred in the central shelf and Gulf of Anadyr when winds are northerly, which has increased melt and led to substantial reductions of ice by mid-May. Although winter sea ice extent has largely maintained its historical cover in the Bering Sea, except for June when sea ice cover has declined, Ray et al. (2016) emphasize that maximum sea ice cover is not a good index for understanding Bering Sea ice change.

Some studies have noted that the Bering Sea ice is not yet experiencing the same warming-driven downward trends as in the Chukchi and Beaufort Seas because Bering Sea dynamics are largely governed by shifts in North Pacific weather which is driven by multi-decadal variability in atmospheric circulation.[27] However, as climate warming continues, researchers anticipate that Bering Sea ice will follow a similar pattern of decline as the Chukchi and Beaufort Seas.[28] Indeed a study by Wang et al. (2010) projected that March and April sea ice cover in the Bering Sea would decline by 43% by 2050 under a mid-range emission scenario.[29]

B. Ocean acidification poses a growing threat to the Pacific walrus

Ocean acidification in the Arctic is occurring at a rapid pace that is expected to cause large-scale disruptions in the food web and in walrus food supply. Seasonal aragonite undersaturation in the Bering Sea, Chukchi Sea, and Canada Basin is already occurring.[30] Mean surface pH values in the Bering, Chukchi and Beaufort Seas have decreased by 0.1 to 0.14 pH

[26] Ray, G.C. et al. 2016. Decadal Bering Sea seascape change: consequences for Pacific walruses and indigenous hunters. Ecological Applications 26(1): 24-41.
[27] Frey et al. 2015
[28] *Id*. at 48.
[29] Wang, M. et al. 2010. Climate projections for selected large marine ecosystems. Journal of Marine Systems 79: 258-266.
[30] Fabry, V.J. et al. 2009. Ocean acidification at high latitudes: the bellweather. Oceanography 22:160-171.

units since pre-industrial times, equivalent to a more than 30% increase in acidity, with future surface pH projected to decrease by another 0.34 to 0.37 pH units by the end of the century.[31]

The Chukchi Sea is particularly vulnerable to ocean acidification because increased sea ice melt, respiration of organic matter, upwelling and river inputs exacerbate CO_2-driven ocean acidification in high-latitude regions.[32] In the northeastern Chukchi Sea, aragonite is becoming partially undersaturated along the bottom in September, and broadly undersaturated in October, and this undersaturation will only worsen with rising emissions: "the penetration of anthropogenic CO_2 into the water column (ocean acidification) has caused these observed undersaturations, which will likely expand as CO_2 levels in the atmosphere continue to rise in the coming decades."[33] In the western Chukchi Sea, nearly 70% of waters next to the seafloor were found to be corrosive to $CaCO_3$ minerals such as aragonite, exposing subsurface benthic communities and nearshore ecosystems to potentially corrosive water.[34] The annual mean aragonite saturation state is projected to pass below the current range of natural variability in the Chukchi Sea in 2027 and the Bering Sea in 2044, putting the ecosystem under "tremendous pressure."[35]

II. Evidence That Anthropogenic Climate Change is Harming the Pacific Walrus

Numerous studies, detailed below, provide additional new evidence that anthropogenic climate change is already harming the Pacific walrus.

A. Evidence of population decline

Taylor and Udevitz (2015) estimated population parameters for the Pacific walrus based on a Bayesian, hidden process demographic model of walrus population dynamics from 1974 through 2006 that combined annual age-specific harvest estimates with five population size estimates, six standing age structure estimates, and two reproductive rate estimates.[36] Their analysis suggests a large-scale population decline of approximately 50% between 1975 and 2003.[37] The researchers state that the decline is consistent with "an extended decline prompted by high harvests of an aging population (Fay et al. 1989), or a change in the environment's capacity to support walruses." They note that "the current environment may be less capable of supporting walruses due to rapidly disappearing sea ice, and recovery to a previous population

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[31] Mathis, J.T. et al. 2015. Ocean acidification risk assessment for Alaska's fishery sector. Progress in Oceanography 136: 71-91, at Table 2.
[32] Mathis, J.T. et al. 2015. Ocean acidification in the surface waters of the Pacific-Arctic boundary regions. Oceanography 28(2): 122–135.
[33] Mathis, J.T. and J.M. Questal. 2013. Assessing seasonal changes in carbonate parameters across small spatial gradients in the Northeastern Chukchi Sea. Continental Shelf Research 67: 42-51, at 42.
[34] Bates, N.R. 2015. Assessing ocean acidification variability in the Pacific- Arctic region as part of the Russian-American Long-term Census of the Arctic. Oceanography 28(3): 36–45.
[35] Mathis, J.T. et al. 2015. Ocean acidification in the surface waters of the Pacific-Arctic boundary regions. Oceanography 28(2): 122–135.
[36] Taylor, R.L. and M.S. Udevitz. 2015. Demography of the Pacific walrus (*Odobenus rosmarus divergens*): 1974-2006. Marine Mammal Science 31: 231-254.
[37] Taylor, R.L. and M.S. Udevitz. 2015, at Figure 2.

equilibrium may not be possible. A hypothesized mechanism for such a change is reduced access to prey, which could impact adult female body condition, and as a result, reproduction, lactation, and calf survival."

B. Increased population stress

Ray et al. (2016) documented substantial changes in Bering Sea sea-ice structure during 2003–2013, which has fundamentally changed the Pacific walruses' winter–spring reproductive and migratory habitat.[38] The researchers emphasized that walruses in winter–spring depend on a critical mass of sea ice habitat to optimize social networking, reproductive fitness, feeding behavior, migration, and energetic efficiency. They warned that the fragmentation of winter habitat "preconditions the walrus population toward dispersal mortality."[39] They concluded that "sea- ice habitat change as it affects walrus behavior is resulting in higher energetic costs during every season of the year, both in the Bering Sea during winter–spring, as indicated here, and in the Chukchi Sea in summer–fall (Jay et al. 2011 , MacCracken 2012)."

Ray et al. (2016) reviewed evidence that walruses prefer "broken pack" in winter–spring, with large herds requiring large areas of semi-continuous habitat. As winter-spring sea ice transitions from a plastic continuum to a "mixing bowl" of ice floes moving relatively independently, herd formation becomes unlikely when ice floes become too widely dispersed or too mixed in types. The study discusses the predictable consequences for the Pacific walrus of habitat fragmentation resulting from sea ice loss and floe structure dispersal, including adverse impacts on reproductive fitness, food- finding, and the efficacy of migration. Key impacts include: (1) impeding the formation of large reproductive arenas that can accommodate territorial males; smaller group sizes with fewer males could reduce male-male competition with impacts on sexual selection and population fitness; (2) disruption of food-finding: social networking allows walruses to explore very large areas of the seafloor where they feed on highly patchy prey; the greater the number of individuals that are seeking food over wide areas, the better the chance of communication of that information to others; (3) energetic costs to mothers and calves: females with newborns are reluctant to enter the water for some time (possibly during most of the 2- month migration period) when they nurse intensively, provide body warmth to vulnerable calves, and closely guard them; the floes on which walrus migrate are usually derived from the same broken pack on which birthing occurred; as the ice breaks up and melts out earlier, walrus mothers and calves would be forced to enter the water, which can impose high thermoregulatory costs to the calves; (4) energetic costs to dispersing walruses: dispersing walrus are subject to higher energetic costs while seeking appropriate sea ice haul-outs, and can experience increased mortality; (5) disruption of the spring migration: the break-up of the sea ice could impose a large increase in migration distance and duration when large polynas develop and move south under the influence of northerly winds.

Furthermore, MacCracken and Benter (2016) detected a recent increase in the fluctuating asymmetry of female Pacific walrus tusks, suggesting that stresses on female walruses have increased in recent years. According to the researchers, "the most likely cause is the decline in

[38] Ray, G.C. et al. 2016. Decadal Bering Sea seascape change: consequences for Pacific walruses and indigenous hunters. Ecological Applications 26(1): 24-41.
[39] Ray, G.C. et al. 2016, at 24.

sea ice habitats in summer in the Chukchi Sea which has become most pronounced since 2007."[40] As noted by the researchers, potential stressors resulting from sea ice loss include the reliance on coastal haulouts for two to three months resulting in increased feeding costs and mortalities, and the rise of development including oil and gas exploration, commercial shipping, and tourism in the Chukchi Sea.

C. Reduced food supply

Sea ice loss and ocean warming is putting the rich benthic-based food web of the Chukchi Sea at risk. As summarized by Grebmeier et al. (2015):

> As sea ice extent declines and seawater warms in this region of the Arctic, the vulnerability of its ecosystem to environmental change is considered high (Grebmeier et al., 2006b; Wassmann et al., 2011; Duarte et al., 2012; Grebmeier, 2012). The duration and extent of seasonal sea ice, seawater temperature, and water mass structure are critical controls on water column production, organic carbon cycling, and pelagic–benthic coupling. Because the productive areas in the Chukchi Sea are associated with short food webs and shallow depths, changes in lower trophic levels can rapidly impact benthic-feeding higher trophic levels, such as walruses, gray whales, and bearded seals (Grebmeier et al., 2006a, 2015; Moore et al., 2014). The recent reduction in seasonal Arctic sea ice could shift the current benthic-based food web to one more dominated by pelagic processes.[41]

A recent study detected significant declines in bivalve species in the southern Chukchi Sea. Specifically, Grebmeier et al. (2015) found that the more sedentary macrofauna, specifically bivalves, showed significant declines in biomass from 2004 to 2012, particularly in the center of the macrobenthic hotspot in the southern Chukchi Sea: "the more sedentary macrofauna show a significant decline in biomass from 2004 to 2012, both for the composite timeseries sites and at select sites located within Anadyr Water."[42] The study found evidence for a decline in the dominant bivalve, *Macoma calcarea*, and other bivalve species at almost all stations. There was also an indication of declining epifaunal biomass since 2009.

Jay et al. (2014) examined site selection by adult radio-tagged walruses relative to the availability of the caloric biomass of benthic infauna and sea ice concentration in the St. Lawrence Island polynya of the northern Bering Sea in 2006, 2008, and 2009.[43] Walrus site selection was related most strongly to tellinid bivalve caloric biomass distribution. The study cautioned that the "projected decreases in sea ice in the St. Lawrence Island polynya and the

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[40] MacCracken, J.G. and R.B. Benter. 2016. Trend in Pacific walrus (*Odobenus rosmarus divergens*) tusk asymmetry, 1990-2014. Marine Mammal Science 32(2): 588-601.
[41] Grebmeier, J.M. et al. 2015. Time-series benthic community composition and biomass and associated environmental characteristics in the Chukchi Sea during the RUSALCA 2004–2012 Program. Oceanography 28(3): 116–133, at 119.
[42] Grebmeier, J.M. et al. 2015.
[43] Jay, C.V. et al. 2014. Pacific walrus (*Odobenus rosmarus divergens*) resource selection in the northern Bering Sea. PLOS ONE 9:e93035.

potential for a concomitant decline of bivalves in the region could result in a northward shift in the wintering grounds of walruses in the northern Bering Sea."

D. Increased dependence on coastal haul-outs

Jay et al. (2012) radio-tracked walruses to estimate areas of walrus foraging and occupancy in the Chukchi Sea from June to November of 2008 to 2011, which were years when sea ice was sparse over the continental shelf compared to historical records.[44] In response to earlier and more extensive sea ice retreat in June to September, and delayed freeze-up of sea ice in October to November, walruses arrived earlier, stayed later, and experienced a longer period of ice-free conditions in the Chukchi Sea than in the past. Importantly, the virtual absence of sea ice over the continental shelf in September and October "caused young and adult female walruses to haul-out on shore in large numbers, a condition that did not occur in the past." The lack of sea ice "caused walruses to forage in nearshore areas in contrast to offshore foraging in the past." In addition, walruses and substantial areas of open water occurred in November in the Chukchi Sea, whereas in the past, most walruses had passed south of the Bering Strait by this month. The researchers noted that "with increasing sea ice loss, it is likely that young and adult female walruses will occupy the Chukchi Sea for longer periods during the year and increase their use of coastal haul-outs and associated nearshore foraging areas."

Jay et al. (2012) documented areas of low levels of foraging which were "largely associated with unavailability of offshore ice for walruses to use for hauling out." The researchers noted that these periods of low levels of foraging resulting from sea ice loss are likely to exact energetic costs, particularly for lactating females and young walruses:

> These periods of low levels of foraging …are likely to affect the level of energy reserves in the blubber of these walruses and their ability to compensate for energetic challenges that may occur in subsequent months. Walruses most vulnerable to altered activity patterns are likely to be lactating females and the young (Noren et al. 2012). Lactating females have double the energy demand of nonreproductive adult females and can only meet the elevated demand by utilizing the stored energy in the blubber. Walruses 2 to 5 yr of age may also be challenged, because they are weaned and have higher mass-specific energetic demands than adults (Noren et al. 2012).[45]

Kryukova et al. (2014) documented recent changes in the use of terrestrial haul-outs in the Gulf of Anadyr in the Bering Sea in relation to sea ice loss. The study found a downward trend in sea ice cover, with an earlier ice melt and longer ice-free period during 2007-2011.[46] The researchers found that the functioning period of haul-outs at Meeskyn Spit and Retkyn Spit became shorter (i.e., the number and duration of walruses decreased) when sea ice disappeared

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[44] Jay, C.V. et al. 2012. Walrus areas of use in the Chukchi Sea during sparse sea ice cover. Marine Ecology Progress Series 468: 1-13.

[45] *Id.*, at 11.

[46] Kryukova, N.V. et al. 2014. The influence of ice conditions on terrestrial haulouts of the Pacific walrus *Odobenus rosmarus divergens* Illiger, 1815 in the Gulf of Anadyr, Bering Sea. Russian Journal of Marine Biology 40: 30–35.

early which was attributed to walruses becoming displaced northward by the retreating sea ice and the regional depletion of food resources.

E. Population impacts of higher mortality at coastal haulouts

An analysis by Udevitz et al. (2013) found that disturbance-related mortality of calves at coastal haulouts is likely to have relatively large negative effect on the population growth rate and "relatively important population consequences."[47] An increase in haulout-related mortality affecting only calves appears to have a greater effect on the population than an equivalent increase in harvest-related mortality distributed among all age classes. The study also posited that increased haulout-related mortality for yearlings would also have a relatively large effect on overall population dynamics.

F. Reduced access to food

Wilt et al. (2014) measured the energetic content of walrus prey items in the southern Chukchi Sea to assess how the foraging energetic of walruses might be impacted as they are forced to use coastal haul-outs instead of sea ice as summer sea ice disappears.[48] The study found a clear latitudinal gradient of increasing caloric density moving from south to north. Importantly, there was a higher caloric density of prey offshore and to the northwest in the COMIDA CAB study area, in regions that are known to be historic feeding grounds. The study concluded that sea ice loss is separating walruses from the highest quality food: "Walruses rely on seasonal ice floes for transport to preferred feeding grounds and for resting platforms over the continental shelf during foraging. Hauling out on Alaskan and Russian shores in response to decreasing amounts of seasonal sea ice separates walruses geographically from the highest quality benthic prey…This finding is also consistent with satellite telemetry data showing walruses making energetically costly efforts to reach these feeding grounds from land (Jay et al. 2012)."

Beatty et al. (2016) examined the effects of environmental variables on foraging Pacific walrus space use patterns.[49] The study found that distance to ice followed by bivalve biomass (Tellinidae) best explained walrus foraging resource selection. The study highlights the importance of sea ice and high bivalve biomass for walrus foraging, both of which are being compromised by rapid sea ice loss.

G. Increased disease exposure and spread

Sonsthagen et al. (2014) compared levels of genetic diversity in walrus populations at a gene associated with adaptive immune response: the Class II major histocompatibility complex

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[47] Udevitz, M.S. et al. 2013. Potential population-level effects of increased haulout-related mortality of Pacific walrus calves. Polar Biology 36: 291-298.
[48] Wilt, L.M. et al. 2014. Caloric content of Chukchi Sea benthic invertebrates: Modeling spatial and environmental variation. Deep-Sea Research II 102: 97-106.
[49] Beatty, W.S. et al. 2016. Space use of a dominant Arctic vertebrate: Effects of prey, sea ice, and land on Pacific walrus resource selection. Biological Conservation 203: 25-32.

(MHC), DQB exon 2.[50] The Pacific walrus had the lowest diversity of any walrus population, and was predominately represented by a single DQB allele. The researchers note that the Pacific walrus's limited genetic diversity for the MHC allele suggests that they may have a reduced ability to handle novel immunological challenges that will come with shifts in ecological communities and environmental stressors. For example, the increased use of coastal haulouts, often with thousands to tens of thousands of animals, can result in increased exposure disease and parasites due to the accumulation of walrus fecal matter and contact with terrestrial and domestic animals and their waste products at haul-outs.[51] In addition, the northward expansion of marine species and their pathogens, and exchange of marine mammals and their pathogens across the Northwest Passage, are likely to increase walrus exposure to novel pathogens. The cause of the Unusual Mortality Event for Northern Alaska Pinnipeds including Pacific walruses that began in 2011 still has not been resolved and raises cause for concern.[52]

H. Threats from increased shipping

As sea ice declines in the Chukchi Sea, vessel traffic has been increasingly steadily through the Bering Strait.[53] Marine shipping in the Bering and Chukchi Seas is projected to increase even more in the coming decades as the open water season lengthens.[54] Arctic shipping activity overall is expected to increase greatly as sea ice declines, with the opening of two international shipping routes—the Northwest Passage and the trans-polar route—and the expansion of the Northern Sea Route.[55] In September 2011, for example, the Northwest Passage and Northern Sea Route were simultaneously ice-free in September. By midcentury in September, common open-water ships are projected to be able to transit the Northern Sea Route, the Northwest Passage will be highly navigable, and there will be new routes crossing the North Pole.[56] Ship traffic diverting from current routes to new routes through the Arctic is projected to reach 2% of global traffic by 2030 and to 5% in 2050; in comparison, shipping volumes through the Suez and Panama canals currently account for about 4% and 8% of global trade volume, respectively.[57] Increased Arctic shipping threatens walruses by increasing the risk of oil spills,

[50] Sonsthagen, S.A et al. 2014. Spatial variation and low diversity in the major histocompatibility complex in walrus (*Odobenus rosmarus*). Polar Biology 37: 497-506.
[51] Udevitz, M.S. et al. 2013, Sonsthagen, S.A et al. 2014.
[52] http://www.north-slope.org/departments/wildlife-management/studies-and-research-projects/ice-seals/2011-ringed-seal-and-walrus-ume
[53] Houck, J. 2013. Commander James Houck, U.S. Coast Guard, Alaska District 17, "Bering Strait maritime overview" (presentation at the Bering Strait Maritime Symposium, Nome, Alaska, Feb. 5–6, 2013), http://seagrant.uaf.edu/conferences/2013/bering-strait-maritime/program.php
[54] ICCT [The International Council on Clean Transportation], 2015. A 10-Year Projection of Maritime Activity in the U.S. Arctic Region. January 1, 2015. http://www.cmts.gov/downloads/CMTS_10-Year_Arctic_Vessel_Projection_Report_1.1.15.pdf
[55] Reeves, R.R. et al. 2014. Distribution of endemic cetaceans in relation to hydrocarbon development and commercial shipping in a warming Arctic. Marine Policy 44: 375-389.
[56] Smith, L.C. and S.R. Stephenson. 2013. New Trans-Arctic shipping routes navigable by midcentury. PNAS 110: 4871-4872.
[57] Corbett, J.J. et al. 2010. Arctic shipping emissions inventories and future scenarios. Atmospheric Chemistry and Physics 10: 9689-9704.

increasing emissions of black carbon that accelerate the local melting of Arctic sea ice by reducing ice albedo,[58] and by disturbing sea ice habitat.

I. Killer whale predation

Another consequence of diminishing sea ice may be the increased opportunity for killer whale predation of walruses. In the Hudson Bay, killer whales are moving into newly ice-free areas that were previously inaccessible,[59] and although killer whales are historically rare in the Chukchi Sea, they may increase in abundance as the Chukchi Sea becomes increasingly ice-free. Kryokova et al. (2012) documented group hunting by killer whales for walruses in August 2008, in the littoral area near Retkyn Spit, Chukotka.[60] Aerts et al. (2013) documented two pods of nine killer whales in the northeastern Chukchi Sea during the open-water season in 2008 which the researchers called a "surprising observation," presumably because pods are considered rare.[61]

III. Existing Regulatory Mechanisms Are Inadequate to Protect the Pacific Walrus

The lack of adequate regulatory mechanisms in the United States to reduce greenhouse gas pollution to levels that are protective of the Pacific walrus's sea ice habitat and marine foraging environment poses a primary threat to the Pacific walrus. While existing domestic laws including the Clean Air Act, Energy Policy and Conservation Act, Clean Water Act, Endangered Species Act, and others provide authority to executive branch agencies to require greenhouse gas (GHG) emissions reductions from virtually all major sources in the United States, these agencies are either failing to implement or only partially implementing these laws for greenhouse gases.

Numerous studies indicate that protecting Arctic sea ice requires holding temperature rise below 1.5°C.[62] Most recently, Notz and Stroeve (2016) estimated that each metric ton of CO_2 emission results in a sustained loss of 3 ± 0.3 m^2 of September Arctic sea ice area based on the robust linear relationship between monthly-mean September sea ice area and cumulative CO_2

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[58] *Id.*

[59] Higdon, J.W. and S.H. Ferguson. 2009. Loss of Arctic sea ice causing punctuated change in sightings of killer whales (*Orcinus orca*) over the past century. Ecological Applications 19: 1365-1375; Higdon, J.W. et al. 2013. Distribution and abundance of killer whales (*Orcinus orca*) in Nunavut, Canada—an Inuit knowledge survey. Journal of the Marine Biological Association of the United Kingdom 94: 1293-1304.

[60] Kryukova, N.V. et al. 2012. Killer whales (*Orcinus orca*) hunting for walruses (*Odobenus rosmarus divergens*) near Retkyn Spit, Chukotka. Biology Bulletin 39: 768-778.

[61] Aerts, L.A.M. et al. 2013. Marine mammal distribution and abundance in an offshore sub-region of the northeastern Chukchi Sea during the open-water season. Continental Shelf Research 67: 116-126.

[62] Schleussner, C.-F. et al. 2016. Science and policy characterstics of the Paris Agreement temperature goal. Nature Climate Change 6: 827-835; Schleussner, C.-F. et al. 2016. Differential climate impacts for policy-relevant limits to global warming: the case of 1.5C and 2C. Earth Systems Dynamics 7: 327-351; U.N. Subsidiary Body for Scientific and Technological Advice. 2015. Report on the Structured Expert Dialogue on the 2013-2015 review FCCC/SB/2015/INF.1; Hansen, J. et al. 2013. Assessing "dangerous climate change": required reduction of carbon emissions to protect young people, future generations and nature. PLoS ONE 8: e81648; Hansen, J. et al. 2008. Target atmospheric CO_2: Where should humanity aim? Open Atmospheric Science Journal 2:217-231.

emissions.[63] Accordingly, each American is responsible, on average, for a shocking loss of almost 50 square meters of sea ice loss per year, equivalent to about 527 square feet of ice loss per person per year.[64] Importantly, the researchers conclude that limiting warming to 2°C is not sufficient to allow Arctic summer sea ice to survive, but that a rapid reduction in emissions to achieve a 1.5°C global warming target gives Arctic summer sea ice "a chance of long-term survival at least in some parts of the Arctic Ocean."[65]

The United States does not have regulatory mechanisms in place sufficient to hold temperature rise below 1.5°C or 2°C above pre-industrial. Although the US has committed to holding the long-term global average temperature "to well below 2°C above pre-industrial levels and to pursue efforts to limit the temperature increase to 1.5°C above pre-industrial levels"[66] under the Paris Agreement,[67] current US regulatory mechanisms are insufficient to meet this target. The United States signed the Paris Agreement on April 22, 2016 as a legally binding instrument through executive agreement,[68] and the treaty entered into force on November 4, 2016. The Paris Agreement codifies the international consensus that climate change is an "urgent threat" of global concern.[69] The Agreement requires a *well below 2°C* climate target because 2°C of warming is no longer considered a safe guardrail for avoiding catastrophic climate impacts such as Arctic sea ice loss and runaway climate change.[70]

Under the Paris Agreement, the United States has pledged a Nationally Determined Contribution (NDC) to reduce net GHG emissions by 26–28% below 2005 levels by 2025 including land use, land use change and forestry (LULUCF), which is equivalent to 19–24% below 2005 levels excluding LULUCF, and equivalent to 6–12% below 1990 levels excluding

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[63] Notz, D. and J. Stroeve. 2016. Observed Arctic sea ice loss directly follows anthropogenic CO_2 emission. Science 10.1126/science.aag2345.
[64] The average American emits 16.4 metric tons of CO_2 per year, which equate to 49 m^2 of sea ice melt each year, equivalent to 527 square feet; http://data.worldbank.org/indicator/EN.ATM.CO2E.PC
[65] Notz, D. and J. Stroeve. 2016, at 3-4.
[66] *See* United Nations Framework Convention on Climate Change, Conference of the Parties Nov. 30-Dec. 11, 2015, Adoption of the Paris Agreement Art. 2, U.N. Doc. FCCC/CP/2015/L.9 (Dec. 12, 2015), available at http://unfccc.int/resource/docs/2015/cop21/eng/l09.pdf ("Paris Agreement").
[67] On December 12, 2015, 197 nation-state and supra-national organization parties meeting in Paris at the 2015 United Nations Framework Convention on Climate Change Conference of the Parties consented to an agreement (Paris Agreement) committing its parties to take action so as to avoid dangerous climate change.
[68] *See* United Nations Treaty Collection, Chapter XXVII, 7.d Paris Agreement, List of Signatories; U.S. Department of State, Background Briefing on the Paris Climate Agreement, (Dec. 12, 2015), http://www. state.gov/ r/pa/prs/ps/2015/12/250592.htm. Although not every provision in the Paris Agreement is legally binding or enforceable, the U.S. and all parties are committed to perform the treaty commitments in good faith under the international legal principle of *pacta sunt servanda* ("agreements must be kept"). Vienna Convention on the Law of Treaties, Art. 26.
[69] *See* Paris Agreement, at Recitals.
[70] *See* the comprehensive scientific review under the United Nations Framework Convention on Climate Change (UNFCCC) of the global impacts of 1.5°C versus 2°C warming: U.N. Subsidiary Body for Scientific and Technological Advice, Report on the Structured Expert Dialogue on the 2013-2015 review (2015), FCCC/SB/2015/INF.1 (2014), http://unfccc.int/resource/docs/2015/sb/eng/inf01.pdf.

LULUCF.[71] However, the US NDC has been ranked as insufficient to keep warming below 2°C by an international team of climate experts[72]: the US NDC is "not yet consistent with limiting warming to below 2°C, let alone with the Paris Agreement's stronger 1.5°C limit."[73] Moreover, current US climate policy is also insufficient to attain the NDC pledge of 26–28% below 2005 in 2025.[74]

A reasonable likelihood of limiting warming to 1.5° or 2°C requires *global* CO_2 emissions to be phased out by mid-century and likely as early as 2040-2045.[75] Developed countries such as the United States must phase out fossil fuel emissions even earlier for a reasonable chance of staying below 2°C.[76] A recent analysis by international team of climate experts suggests that the US must reduce its greenhouse gas emissions by 68 to 106% below 1990 levels by 2025, with the range of reductions depending on the equity and sharing principles, for a likely probability of limiting warming to 2°C.[77] However, the US NDC pledged reductions of only 6–12% below 1990 levels by 2025.

The inadequacy of US regulatory mechanisms to keep temperature rise below 1.5° or well below 2°C is also evident from a carbon budget perspective. Put simply, there is only a finite amount of CO_2 that can be released into the atmosphere without rendering the goal of meeting a 1.5°C or well below 2°C target virtually impossible. The IPCC Fifth Assessment Report and other expert assessments have established global carbon budgets, or the total amount of carbon that can be burned while maintaining some probability of staying below a given temperature target. According to the IPCC, total cumulative anthropogenic emissions of CO_2 must remain below about 1,000 gigatonnes ($GtCO_2$) from 2011 onward for a 66% probability of limiting warming to 2°C above pre-industrial levels, and to 400 $GtCO_2$ from 2011 onward for a 66% probability of limiting warming to 1.5°C.[78] These carbon budgets have been reduced to 850

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[71] *See* the US Nationally Determined Contribution submitted to the UNFCCC: http://www4.unfccc.int/Submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf

[72] Climate Action Tracker is a joint project of Climate Analytics, Ecofys, Potsdam Institute for Climate Impact Research, and the NewClimate Institute.

[73] Climate Action Tracker. 2016. USA analysis, updated 2 November 2016, http://climateactiontracker.org/countries/usa.html

[74] *Id.*

[75] See Rogelj, J. et al. 2015. Energy system transformations for limiting end-of-century warming to below 1.5°C. Nature Climate Change 5: 519-528.

[76] Climate Action Tracker. 2014. Below 2C or 1.5C depends on rapid action from both Annex I and Non-Annex I countries. Policy Brief. 4 June 2014.

[77] Climate Action Tracker. 2015. Are governments doing their "fair share"? New method assesses climate action. 27 March 2015. *See* Figures 2 and 3.

[78] IPCC [Intergovernmental Panel on Climate Change]. 2013. The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Summary for Policymakers, at 27; IPCC [Intergovernmental Panel on Climate Change]. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp, at 63-64 & Table 2.2.

$GtCO_2$ and 240 $GtCO_2$, respectively, from 2015 onward.[79] Given that global CO_2 emissions in 2015 alone totaled 36 $GtCO_2$,[80] the remaining carbon budget is being rapidly consumed.

According to a large body of scientific research, the vast majority of the world's fossil fuels must stay in the ground in order to stay within the carbon budget needed to hold temperature rise to 1.5° or 2°C.[81] Studies estimate that 68 to 80 percent of global fossil fuel reserves must be kept in the ground to limit temperature rise to 2°C based on a 1,000 $GtCO_2$ carbon budget.[82] For a 50% chance of limiting temperature rise to 1.5°C, 85 percent of known fossil fuel reserves must stay in the ground.[83] However, the US is not on track to limit fossil fuel extraction and phase out fossil fuel emissions to the extent needed to stay within the carbon budget for limiting warming to 1.5° or well below 2°C.

A 2016 analysis found that potential carbon emissions from *already developed* reserves in currently operating oil and gas fields and mines would lead to global temperature rise beyond 2°C.[84] Excluding coal, currently operating oil and gas fields alone would take the world beyond 1.5°C.[85] To stay well below 2°C, the analysis concludes that no new fossil fuel extraction or transportation infrastructure should be built, and governments should grant no new permits for new fossil fuel extraction and infrastructure.[86] Moreover, some fields and mines, primarily in rich countries, must be closed before fully exploiting their resources. The analysis concludes that, because "existing fossil fuel reserves considerably exceed both the 2°C and 1.5°C carbon budgets[, i]t follows that exploration for new fossil fuel reserves is at best a waste of money and at worst very dangerous."[87] Yet the US has not taken the steps to end new fossil fuel extraction and infrastructure or close already developed reserves.

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[79] See Table 2 in Rogelj, J. et al. 2016. Differences between carbon budget estimates unraveled. Nature Climate Change 6: 245-252.

[80] *See* Global Carbon Budget 2016, www.globalcarbonproject.org/carbonbudget/16/data.htm; *See also* Le Quéré, C. et al. 2016. Global Carbon Budget 2016. Earth Syst. Sci. Data 8: 605-649.

[81] Global fossil fuel reserves, not including the larger pool of recoverable resources, if extracted and burned, would exceed the allowable carbon budget for a 2°C limit several times over. The IPCC estimates that global fossil fuel reserves exceed the remaining carbon budget for staying below 2°C by 4 to 7 times, while fossil fuel resources exceed the carbon budget for 2°C by 31 to 50 times. *See* Bruckner T. et al. 2014. Energy Systems. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, at Table 7.2.

[82] To limit temperature rise to 2°C based on a 1,000 $GtCO_2$ carbon budget from 2011 onward, studies indicate variously that 80% (Carbon Tracker Initiative 2013), 76% (Raupach et al. 2014), and 68% (Oil Change International 2016) of global fossil fuel reserves must stay in the ground. *See* Carbon Tracker Initiative. 2013. Unburnable Carbon – Are the world's financial markets carrying a carbon bubble?, http://www.carbontracker.org/wp-content/uploads/2014/09/Unburnable-Carbon-Full-rev2-1.pdf; Raupach, M. et al. 2014. Sharing a quota on cumulative carbon emissions. Nature Climate Change 4: 873-879; Oil Change International. 2016. The Sky's Limit: Why the Paris Climate Goals Require A Managed Decline of Fossil Fuel Production, September 2016.

[83] Oil Change International. 2016. The Sky's Limit: Why the Paris Climate Goals Require A Managed Decline of Fossil Fuel Production, September 2016.

[84] Oil Change International. 2016, at 5.

[85] Oil Change International. 2016, at 5.

[86] Oil Change International. 2016, at 5.

[87] Oil Change International. 2016, at 17.

The urgency for the United States to take stronger action to phase out fossil fuel extraction was highlighted by a 2015 analysis that found that the US must keep the vast majority of fossil fuels in the ground to stay within the carbon budget for limiting warming to 1.5° or well below 2°C. According to this analysis, the US alone has enough recoverable fossil fuels, split about evenly between federal and non-federal resources, that if extracted and burned, would exceed the global carbon budget for a 1.5°C limit, and would consume nearly the entire global budget for a 2°C limit.[88] Specifically, the analysis found:

- Potential GHG emissions of federal fossil fuels if developed would release up to 492 gigatons (Gt) of carbon dioxide equivalent pollution (CO_2e), representing 46 percent to 50 percent of potential emissions from all remaining U.S. fossil fuels.
- Of that amount, up to 450 Gt CO_2e have not yet been leased to private industry for extraction;
- Releasing those 450 Gt CO_2e (the equivalent annual pollution of more than 118,000 coal-fired power plants) would be greater than any proposed U.S. share of global carbon limits that would keep emissions well below 2°C.[89]

In sum, full implementation of our flagship environmental laws, particularly the Clean Air Act, would provide an effective and comprehensive greenhouse gas reduction strategy. Until and unless these mechanisms are fully implemented and combined with additional national and international efforts that sufficiently protect Arctic sea ice and limit ocean acidification, the Pacific walrus remains in danger from climate change and ocean acidification.

IV. The International Trade in Walrus Ivory is Significant

There is a significant, international trade in walrus ivory. As the Service is aware, walrus (*Odobenus rosmarus*) is currently listed by Canada on Appendix III of the Convention on International Trade in Endangered Species (CITES). Accordingly, pursuant to CITES, export of any walrus specimen from Canada requires an export permit, ensuring the specimen was obtained legally, but export from any other nation-Party does not require permitting.[90] However, every nation must nonetheless "maintain records of trade" in all specimens listed on any Appendix, including Appendix III, and report annually to CITES authorities on that trade.[91]

It is difficult to estimate how many walrus are traded internationally each year. In 2014, TRAFFIC issued a report assessing the international trade and management of walruses around

[88] Ecoshift Consulting, et al. 2015. The Potential Greenhouse Gas Emissions of U.S. Federal Fossil Fuels. Prepared for Center for Biological Diversity & Friends of the Earth. Available at http://www.ecoshiftconsulting.com/wpcontent/uploads/Potential-Greenhouse-Gas-Emissions-U-S-Federal-Fossil-Fuels.pdf

[89] For the United States, Raupach et al. (2014) provide a mid-range estimate of the U.S. carbon quota of 158 $GtCO_2$ for a 50% chance of staying below 2°C, using a "blended" scenario of sharing principles for allocating the global carbon budget among countries. This study estimates US fossil fuel reserves at 716 $GtCO_2$, of which coal comprises the vast majority, indicating that most fossil fuel reserves in the US must remain unburned to meet a well below 2°C carbon budget. See Supplementary Figure 7 in Raupach, M. et al. 2014. Sharing a quota on cumulative carbon emissions. Nature Climate Change 4: 873-879.

[90] CITES, Art. V.

[91] *Id.*, Art. VIII(6), (7).

the world, noting trade in a variety of specimens, including carvings, skulls, tusks, teeth, and other items.[92] The report estimated that, based on CITES data from 2005 to 2009, between 461 and 772 walruses were traded internationally, with roughly 7,181 walrus parts and derivatives exported in the same time frame.[93] With several caveats, the report concluded that "the available information does not suggest that international trade currently poses a threat to walrus conservation."[94]

However, the report's estimates are conservative, likely substantially underestimating the actual number of walruses in trade. Specifically, the authors estimated the number of walrus in trade based upon the number of walrus skulls and tusks in trade, as a skull or two tusks reasonably represents a single, dead walrus. The authors were understandably unable to estimate how many dead walruses are represented by the number of carvings, bones, or ivory in trade, because the data do not disclose the sizes or specifications of these items, which could either be small fractions of a tusk or potentially a full tusk. Accordingly, the authors did not consider the trade in carvings, bones, and ivory in their estimates. Yet the vast majority of international walrus trade occurs in these items. For example, between 2005 and 2009, only 149 walrus skulls and 623 tusks were exported.[95] In comparison, during the same period, according to the report, around 4,850 "bones, ivory, and carvings" were traded.[96] Undoubtedly, those bones, ivory, and carved items may individually or cumulatively represent numerous dead walruses, thus the report's estimate of 461 to 772 walruses in trade is an underestimate.

Further, when we reviewed the CITES data for 2009, we found substantially higher levels of trade in carvings, bones, ivory and other items than reported by TRAFFIC. Specifically, the CITES data revealed that in 2009, 28,146 specimens were exported (including all skulls, tusks, bones, carvings, ivory, teeth, and other items).[97] In contrast, TRAFFIC reported 975 items exported in 2009.[98] While we found similar numbers of skulls and tusks imported to what TRAFFIC reported, we found substantially more carvings, bones, and ivory in trade. It is unclear why the numbers are inconsistent; however, the CITES data suggests a substantially greater trade volume.

We also reviewed the CITES data from 2010-2014, five years beyond the timeframe covered by the TRAFFIC report. *See* Table 1 (below). The 2010-2014 data revealed substantially higher levels of trade in both tusks and skulls than reported by TRAFFIC for 2005-2009. Our review of the 2010-2014 data also revealed substantially higher levels of trade in carvings, bones, and ivory, resulting in higher trade overall, compared to TRAFFIC's 2005-2009 data; however, as noted above, that data is not directly comparable, as we may be calculating the data differently.

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[92] Shadbolt, T. et al. 2014. Hauling Out: International Trade and Management of Walrus. TRAFFIC and WWF-Canada. Vancouver, B.C.
[93] *Id.* at 89, 61.
[94] *Id.* at 90.
[95] *Id.* at 83, 86.
[96] *Id.* at 87.
[97] *Source:* Comparative tabulation of export data extracted from the UNEP-WCMC CITES Trade Database for 2009, attached as Annex A.
[98] Shadbolt, T. et al. 2014., at 78.

Table 1. CITES Trade Data, *Odobenus rosmarus* (Walrus) Exports, 2010-2014
Source: Comparative tabulation of export data extracted from the UNEP-WCMC CITES Trade Database.

	Individual Tusks	Skulls	Total specimens
2010	310	47	25,030
2011	208	23	15,284
2012	189	41	12,870
2013	173	43	1,914
2014	205	55	1,471
Total	**1085**	**209**	**56,595**
Traffic 5-year Totals (2005-2009)	637	166	7181

We note that there are several inconsistencies in the CITES data. With only a few exceptions, the quantity of specimens reported as exported does not match the quantity reported as imported. This raises serious questions about how and whether walrus specimens are being tracked in trade, and it is likely some of the imports recorded were not recorded as exports, thus trade may be higher than export numbers alone suggest.

Finally, the export/import data raises serious concerns about the legality of walrus imports into the United States. Every year from 2010-2014, the CITES data show at least one massive export of walrus products from Indonesia to the United States. For example, in 2010, the data show that 10,592 "ivory carvings" were exported from Indonesia to the United States for trade purposes in a single shipment. These carvings were sourced from wild walruses in the United States. Similarly, in 2012, 14,161 "ivory carvings" were exported from Indonesia to the United States for trade purposes in a single shipment, again sourced from wild walruses in the United States.

The MMPA bans the import of marine mammals, including "any part" of any marine mammal, with limited exceptions.[99] Specifically:

> A marine mammal product may be imported into the United States if the product—
> (i) was legally possessed and exported by any citizen of the United States in conjunction with travel outside the United States, provided that the product is imported into the United States by the same person upon the termination of travel;
> (ii) was acquired outside of the United States as part of a cultural exchange by an Indian, Aleut, or Eskimo residing in Alaska [with a Native inhabitant of Russia, Canada, or Greenland]; or
> (iii) is owned by a Native inhabitant of Russia, Canada, or Greenland and is imported for noncommercial purposes in conjunction with travel within the United States or

[99] 16 U.S.C. §§ 1371(a); 1362(6).

as part of a cultural exchange with an Indian, Aleut, or Eskimo residing in Alaska.[100]

Because exemptions (i) and (iii) clearly do not apply to imports for commercial trade purposes, and exemption (ii) only allows products imported as part of a cultural exchange with Native peoples of Russia, Canada, or Greenland, the commercial import of walrus ivory carvings from Indonesia is prohibited. We urge the Service to investigate this and other importation documented into the United States, as well as any commercial export of walrus out of the United States, for compliance with the MMPA.

V. The Projected Future Status of the Pacific Walrus Supports ESA Listing

Jay et al. (2010) developed a Bayesian network model to integrate the effects of changing environmental conditions and anthropogenic stressors in order to project the future status of the Pacific walrus population at four periods in the twenty-first century.[101] Based on 2010 model inputs, the summed probabilities of vulnerable, rare, and extirpated increased from a current level of 10% in 2004 to 22% by 2050 and 40% by 2095. The outcomes of this model were used to inform the Service's determination in 2011 that the Pacific walrus warrants ESA listing. This study was later published as Jay et al. (2011).[102]

As detailed in our letter submitted on September 24, 2010 and incorporated herein by reference, the Jay et al. (2010, 2011) model was based on sea ice projections that failed to capture the observed rapid rate of sea ice decline, and included a series of assumptions that resulted in underestimates of extinction risk for the Pacific walrus. For example, key threats, including the effects of climate change on the walrus's food supply, ocean acidification, and shipping, had negligible influence on walrus status in the model. This is not supported by the best available science indicating that these threats are already exerting more than negligible influence on walrus habitat, and should be weighed more heavily in the model. Furthermore, since 2010, the primary threats to the walrus have only worsened. Updating and improving the model with the best available science reviewed in this letter is important for assessing walrus extinction risk and provides further evidence of the walrus's vulnerability.

We recommend that updates and improvements to the 2010/2011 model include the following:

(1) The CMIP3 climate models used in the 2010/2011 sea ice analysis significantly underpredict the observed rate of sea ice loss and likely significantly under-represent the future rate of sea ice loss in the Bering and Chukchi Seas. The model should be updated with the CMIP5 climate models that better reproduce observed sea ice loss. However, as discussed above,

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[100] *Id.* § 1371(a)(6).
[101] Jay, C.V. et al. 2010. Projected status of the Pacific walrus (*Odobenus rosmarus divergens*) in the 21st century. US Geological Survey. Administrative Report, Submitted to the U.S. Fish and Wildlife Service, September 10, 2010.
[102] Jay, C.V. et al. 2011. Projected status of the Pacific walrus (*Odobenus rosmarus divergens*) in the twenty-first century. Polar Biology 34:1065-1084.

even these improved models underpredict sea ice loss, making it important to select a subset of CMIP5 models that best simulate the extent and seasonality of observed sea ice loss.

(2) In the 2010/2011 model, the abundance stressors projected in spring were less than those projected in summer/fall because sea ice conditions in spring were not expected to degrade as greatly as in summer/fall. Additionally, winter sea ice conditions had only small adverse effects on all-season walrus outcomes. However, these assumptions are not realistic and do not represent the best available science. For example, as detailed above, the study by Ray et al. (2016) indicates that winter-spring sea ice conditions in the Bering Sea have already undergone substantial changes from a plastic continuum to a mixing bowl of ice floes with early break-up and melt that are unfavorable for walrus reproduction, foraging, and migration.

(3) The 2010/2011 model forecast a negligible influence of "climate change on benthos" and "ship and air traffic" which the authors acknowledged is a reflection of the "uncertainty in the magnitude and timing in which the factors might be expressed and the degree of stress that the factors could impart" rather than "certain knowledge that these factors are trivial." However, the negligible influence of these stressors in the model does not reflect the current state of the science. As detailed above, Grebmeier et al. (2015) documented a decline in bivalves in the important benthic hotspot in the southern Chukchi Sea since 2004. Moreover, vessel traffic has been increasing through the Bering Strait, with related risks from disturbance and oil spills.

(4) The 2010/2011 model included a negligible influence of ocean acidification on walrus status because "forecasts are uncertain for saturation levels of carbonate minerals in the Chukchi Sea." However, as detailed above, aragonite undersaturation is already occurring in the Chukchi Sea. Moreover, the annual mean aragonite saturation state is projected to pass below the current range of natural variability in the Chukchi Sea in 2027, putting the ecosystem under "tremendous pressure."[103]

VI. Judicial Rulings Provide Essential Direction for the Service's Determination

Two recent judicial rulings provide essential direction for the Service's listing determination for the Pacific walrus. The Court of Appeals for the Ninth Circuit issued a ruling in 2016 that discusses the application of the ESA's listing provisions for a species threatened by climate change. See Alaska Oil & Gas Ass'n v. Pritzker, — F.3d — (9th Cir. Oct. 24, 2016). The Montana district court's ruling in Defenders of Wildlife v. Jewell, 2016 WL 1363865, affirmed that the ESA does not demand precise, ironclad, or absolute information to support a listing determination.

A. Alaska Oil & Gas Association v. Pritzker

In Alaska Oil & Gas Association v. Pritzker ("AOGA"), the Ninth Circuit addressed a challenge to the National Marine Fisheries Service's ("NMFS") decision to list a DPS of the Pacific bearded seal subspecies as threatened under the ESA. Like the Pacific walrus, the bearded seal is (1) a sea ice dependent species for which population size is difficult to estimate;

[103] Mathis, J.T. et al. 2015. Ocean acidification in the surface waters of the Pacific-Arctic boundary regions. Oceanography 28(2): 122–135.

(2) a species that is dependent on physical habitat features that are threatened by a warming climate; and (3) a species for which predictive climate modeling was used to project widespread loss of essential habitat features throughout the 21st century.

The AOGA court upheld NMFS's listing determination for the bearded seal and, in so doing, reached a number of important holdings that are applicable to the Pacific walrus:

- The court reaffirmed that "the IPCC climate models constitute[] the 'best available science' and reasonably support[] the determination that a species reliant on sea ice likely would become endangered in the foreseeable future." [cite]. The court further stated that "[t]he fact that climate projections for 2050 through 2100 may be volatile does not deprive those projections of value in the rulemaking process [because] [t]he ESA does not require NMFS to make listing decisions only if underlying research is ironclad and absolute."

- The court rejected the argument that listing was unjustified because NMFS "failed to provide an evidence-based explanation for the relationship between habitat loss and the bearded seal's survival" and because, "at the time NMFS issued its final listing rule, the bearded seal had not suffered population losses." The court observed that the best available data at the time of listing demonstrated that a decrease in sea ice availability would adversely affect the bearded seal, and that "[u]ncertainty regarding the speed and magnitude of that adverse impact … does not invalidate data presented in the administrative record that reasonably supports the conclusion that loss of habitat at key life stages will likely jeopardize" the species.

- The court held that "[t]he Service need not wait until a species' habitat is destroyed to determine that habitat loss may facilitate extinction," and that "the ESA does not require an agency to quantify population losses, the magnitude of risk, or a projected 'extinction date' or 'extinction threshold' to determine whether a species is 'more likely than not' to become endangered in the foreseeable future."

B. Defenders of Wildlife v. Jewell

The Ninth Circuit's AOGA ruling echoed key aspects of the Montana district court's rejection of the Service's withdrawal decision for the American wolverine in Defenders of Wildlife v. Jewell. Most significantly, like the subsequent AOGA decision, the Defenders of Wildlife ruling made clear that the ESA does not demand precise, ironclad, or absolute information to support a listing determination. Thus, Defenders of Wildlife held that "the Service cannot demand a greater level of scientific certainty than has been achieved in the field to date." 2016 WL 1363865, at *22.

VII. Conclusion

As detailed in these comments and supported by the best available science, the Pacific walrus clearly merits ESA listing as a threatened or endangered species. We are sending all the references cited in these comments on a compact disk to the Alaska Regional Office. Please do not hesitate to contact us if you have any questions.

Sincerely,

/s/ Shaye Wolf
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References cited

Aerts, L.A.M. et al. 2013. Marine mammal distribution and abundance in an offshore sub-region of the northeastern Chukchi Sea during the open-water season. Continental Shelf Research 67: 116-126.

Bates, N.R. 2015. Assessing ocean acidification variability in the Pacific-Arctic region as part of the Russian-American Long-term Census of the Arctic. Oceanography 28(3): 36–45.

Beatty, W.S. et al. 2016. Space use of a dominant Arctic vertebrate: Effects of prey, sea ice, and land on Pacific walrus resource selection. Biological Conservation 203: 25-32.

Bruckner T. et al. 2014. Energy Systems. In: Climate Change 2014: Mitigation of Climate Change. Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Carbon Tracker Initiative. 2013. Unburnable Carbon – Are the world's financial markets carrying a carbon bubble?, http://www.carbontracker.org/wp-content/uploads/2014/09/Unburnable-Carbon-Full-rev2-1.pdf

Climate Action Tracker. 2014. Below 2C or 1.5C depends on rapid action from both Annex I and Non-Annex I countries. Policy Brief. 4 June 2014.

Climate Action Tracker. 2015. Are governments doing their "fair share"? New method assesses climate action. 27 March 2015.

Climate Action Tracker. 2016. USA analysis, updated 2 November 2016, http://climateactiontracker.org/countries/usa.html

Corbett, J.J. et al. 2010. Arctic shipping emissions inventories and future scenarios. Atmospheric Chemistry and Physics 10: 9689-9704.

Ecoshift Consulting, et al. 2015. The Potential Greenhouse Gas Emissions of U.S. Federal Fossil Fuels. Prepared for Center for Biological Diversity & Friends of the Earth, http://www.ecoshiftconsulting.com/wpcontent/uploads/Potential-Greenhouse-Gas-Emissions-U-S-Federal-Fossil-Fuels.pdf

Fabry, V.J. et al. 2009. Ocean acidification at high latitudes: the bellweather. Oceanography 22:160-171.

Frey, K.E. et al. 2015. Divergent patterns of recent sea ice cover across the Bering, Chukchi and Beaufort seas of the Pacific Arctic Region. Progress in Oceanography 136: 32-49.

Global Carbon Budget. 2016, www.globalcarbonproject.org/carbonbudget/16/data.htm

Grebmeier, J.M. et al. 2015. Time-series benthic community composition and biomass and associated environmental characteristics in the Chukchi Sea during the RUSALCA 2004–2012 Program. Oceanography 28(3): 116–133.

Hansen, J. et al. 2008. Target atmospheric CO_2: Where should humanity aim? Open Atmospheric Science Journal 2: 217-231.

Hansen, J. et al. 2013. Assessing "dangerous climate change": required reduction of carbon emissions to protect young people, future generations and nature. PLoS ONE 8: e81648.

Higdon, J.W. and S.H. Ferguson. 2009. Loss of Arctic sea ice causing punctuated change in sightings of killer whales (*Orcinus orca*) over the past century. Ecological Applications 19: 1365-1375.

Higdon, J.W. et al. 2013. Distribution and abundance of killer whales (*Orcinus orca*) in Nunavut, Canada—an Inuit knowledge survey. Journal of the Marine Biological Association of the United Kingdom 94: 1293-1304.

Houck, J. 2013. Commander James Houck, U.S. Coast Guard, Alaska District 17, "Bering Strait maritime overview" (presentation at the Bering Strait Maritime Symposium, Nome, Alaska, Feb. 5–6, 2013), http://seagrant.uaf.edu/conferences/2013/bering-strait-maritime/program.php

ICCT [The International Council on Clean Transportation]. 2015. A 10-Year Projection of Maritime Activity in the U.S. Arctic Region. January 1, 2015. http://www.cmts.gov/downloads/CMTS_10-Year_Arctic_Vessel_Projection_Report_1.1.15.pdf

IPCC [Intergovernmental Panel on Climate Change]. 2013. The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Summary for Policymakers.

IPCC [Intergovernmental Panel on Climate Change]. 2014. Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (eds.)]. IPCC, Geneva, Switzerland, 151 pp.

Jay, C.V. et al. 2010. Projected status of the Pacific walrus (*Odobenus rosmarus divergens*) in the 21st century. US Geological Survey. Administrative Report, Submitted to the U.S. Fish and Wildlife Service, September 10, 2010.

Jay, C.V. et al. 2011. Projected status of the Pacific walrus (*Odobenus rosmarus divergens*) in the twenty-first century. Polar Biology 34:1065-1084.

Jay, C.V. et al. 2012. Walrus areas of use in the Chukchi Sea during sparse sea ice cover. Marine Ecology Progress Series 468:1-13.

Jay, C.V. et al. 2014. Pacific walrus (*Odobenus rosmarus divergens*) resource selection in the northern Bering Sea. PLOS ONE 9:e93035.

Kryukova, N.V. et al. 2012. Killer whales (*Orcinus orca*) hunting for walruses (*Odobenus rosmarus divergens*) near Retkyn Spit, Chukotka. Biology Bulletin 39: 768-778.

Kryukova, N.V. et al. 2014. The influence of ice conditions on terrestrial haulouts of the Pacific walrus *Odobenus rosmarus divergens* Illiger, 1815 in the Gulf of Anadyr, Bering Sea. Russian Journal of Marine Biology 40: 30–35.

Kwok, R., and D. A. Rothrock. 2009. Decline in Arctic sea ice thickness from submarine and ICESat records: 1958-2008. Geophysical Research Letters 36: L15501.

Le Quéré, C. et al. 2016. Global Carbon Budget 2016. Earth Syst. Sci. Data 8: 605-649.

Lindsay, R. and A. Schweiger. 2015. Arctic sea ice thickness loss determined using subsurface, aircraft, and satellite observations. Cryosphere 9: 269-283.

MacCracken, J.G. and R.B. Benter. 2016. Trend in Pacific walrus (*Odobenus rosmarus divergens*) tusk asymmetry, 1990-2014. Marine Mammal Science 32(2): 588-601.

Mathis, J.T. and J.M. Questal. 2013. Assessing seasonal changes in carbonate parameters across small spatial gradients in the Northeastern Chukchi Sea. Continental Shelf Research 67: 42-51.

Mathis, J.T. et al. 2015. Ocean acidification risk assessment for Alaska's fishery sector. Progress in Oceanography 136: 71-91.

Mathis, J.T. et al. 2015. Ocean acidification in the surface waters of the Pacific-Arctic boundary regions. Oceanography 28(2): 122–135.

Meier, W.N. et al. 2014. Arctic sea ice in transformation: A review of recent observed changes and impacts on biology and human activity. Rev. Geophys 51: 185–217.

Notz, D. and J. Stroeve. 2016. Observed Arctic sea ice loss directly follows anthropogenic CO_2 emission. Science 10.1126/science.aag2345.

NSIDC [National Snow and Ice Data Center]. 2016. September 2016 Compared to Previous Years, 5 October 2016, http://nsidc.org/arcticseaicenews/2016/10/

NSIDC [National Snow and Ice Data Center]. 2016. March 2016 Compared to Previous Years, 6 April 2016, https://nsidc.org/arcticseaicenews/2016/04/

Oil Change International. 2016. The Sky's Limit: Why the Paris Climate Goals Require A Managed Decline of Fossil Fuel Production, September 2016.

Overland, J.E. and M. Wang. 2013. When will the summer Arctic be nearly sea ice free? Geophysical Research Letters 40: 2097-2101.

Parkinson, C.L. 2014. Spatially mapped reductions in the length of the Arctic sea ice season, Geophysical Research Letters 41: 4316–4322.

Raupach, M. et al. 2014. Sharing a quota on cumulative carbon emissions. Nature Climate Change 4: 873-879

Ray, G.C. et al. 2016. Decadal Bering Sea seascape change: consequences for Pacific walruses and indigenous hunters. Ecological Applications 26(1): 24-41.

Reeves, R.R. et al. 2014. Distribution of endemic cetaceans in relation to hydrocarbon development and commercial shipping in a warming Arctic. Marine Policy 44: 375-389.

Rogelj, J. et al. 2015. Energy system transformations for limiting end-of-century warming to below 1.5°C. Nature Climate Change 5: 519-528.

Rogelj, J. et al. 2016. Differences between carbon budget estimates unraveled. Nature Climate Change 6: 245-252.

Schleussner, C.-F. et al. 2016. Science and policy characterstics of the Paris Agreement temperature goal. Nature Climate Change 6: 827-835.

Schleussner, C.-F. et al. 2016. Differential climate impacts for policy-relevant limits to global warming: the case of 1.5C and 2C. Earth Systems Dynamics 7: 327-351.

Shadbolt, T. et al. 2014. Hauling Out: International Trade and Management of Walrus. TRAFFIC and WWF-Canada. Vancouver, B.C.

Smith, L.C. and S.R. Stephenson. 2013. New Trans-Arctic shipping routes navigable by midcentury. PNAS 110: 4871-4872.

Sonsthagen, S.A et al. 2014. Spatial variation and low diversity in the major histocompatibility complex in walrus (*Odobenus rosmarus*). Polar Biology 37: 497-506.

Stroeve, J. et al. 2007. Arctic sea ice decline: Faster than forecast. Geophysical Research Letters 34: L09501.

Stroeve, J. et al. 2008. Arctic sea ice extent plummets in 2007. EOS Transactions 89:13-14.

Stroeve, J.C. et al. 2014. Changes in Arctic melt season and implications for sea ice loss. Geophysical Research Letters 41: 1216-1225.

Taylor, R.L. and M.S. Udevitz. 2015. Demography of the Pacific walrus (*Odobenus rosmarus divergens*): 1974-2006. Marine Mammal Science 31: 231-254.

Udevitz, M.S. et al. 2013. Potential population-level effects of increased haulout-related mortality of Pacific walrus calves. Polar Biology 36: 291-298.

United Nations Framework Convention on Climate Change, Conference of the Parties Nov. 30-Dec. 11, 2015, Adoption of the Paris Agreement Art. 2, U.N. Doc. FCCC/CP/2015/L.9 (Dec. 12, 2015), available at http://unfccc.int/resource/docs/2015/cop21/eng/l09.pdf ("Paris Agreement").

U.N. Subsidiary Body for Scientific and Technological Advice. 2015. Report on the Structured Expert Dialogue on the 2013-2015 review FCCC/SB/2015/1NF.1

US Nationally Determined Contribution, 2016, submitted to the UNFCCC: http://www4.unfccc.int/Submissions/INDC/Published%20Documents/United%20States%20of%20America/1/U.S.%20Cover%20Note%20INDC%20and%20Accompanying%20Information.pdf

Wang, M. et al. 2010. Climate projections for selected large marine ecosystems. Journal of Marine Systems 79: 258-266.

Wang, M. and J.E. Overland. 2015. Projected future duration of the sea ice-free season in the Alaskan Arctic. Progress in Oceanography 136: 50-59.

Wilt, L.M. et al. 2014. Caloric content of Chukchi Sea benthic invertebrates: Modeling spatial and environmental variation. Deep-Sea Research II 102: 97-106.

Wood, K.R. et al. 2015. A decade of environmental change in the Pacific Arctic region. Progress in Oceanography 136: 12-31.

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IN REPLY REFER TO:

FWS/RD

APR 10 2017

Memorandum

To: THE RECORD

From: Regional Director – Region 7 Greg Siekaniec

Subject: Pacific Walrus Endangered Species Act Listing

At the conclusion of the Pacific walrus Endangered Species Act (ESA) listing decision team meeting on February 24, 2017, the four member decision team was split on their recommendation as to whether the species met the definition of threatened and therefore warrants listing under the ESA. All four members agreed that the species did not meet the definition of endangered. At the conclusion of the meeting, I indicated I was inclined to support the recommendation of the two members of the decision team with more ESA experience. Therefore, my recommendation at the close of the decision team meeting was that Pacific walrus warranted listing as a threated species. Following the meeting, I spent additional time reviewing and discussing the information provided in the Species Status Assessment (SSA) document and have concluded that the best available information at this time supports a determination that Pacific walruses are not likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range and therefore listing under the ESA is not warranted.

The major driver in considering the future status of the Pacific walrus is the projection of sea ice changes and the resulting changes in behavior with associated impacts on survival and recruitment. In considering likely future conditions, critical decisions were which sea ice modeling scenarios to consider and over what timeframe.

The decision team considered a range of sea ice modeling projections. The SSA contained sea ice projections for the 2.6, 4.5, and 8.5 Representative Concentration Pathways (RCPs). RCP 8.5 and RCP 2.6 scenarios provide the upper and lower limit of 21st century emission pathways and therefore the upper and lower limits to the persistence of sea ice. The decision team did not believe that the best available information supported reliance upon RCP 2.6 given that it depends on aggressive emission reductions that are not reasonably certain to occur. RCP 4.5 is a stabilization scenario that assumes that climate policies are invoked to achieve the goal of limiting emissions and therefore concentrations and radiative forcing. RCP 8.5 is generally considered the business as usual model and reflects no commitment or effort to reduce

emissions. The decision team focused their discussions primarily on the RCP 8.5 scenario. I believe it is important and appropriate to consider RCP 8.5 modeling scenario as the worst case scenario, but useful to also consider the projections under the RCP 4.5 scenario as a possible outcome. These two scenarios provide us with a range of likely predicted sea ice changes.

In considering the foreseeable future, we consider the best available data that allows reliable predictions into the future. When the point is reached that a conclusion concerning the trends or the impacts of a particular threat are based on speculation rather than reliable prediction, those impacts are not within the foreseeable future. The Science Team included projections in the SSA out to 2100, but cautioned against relying upon those and instead recommended greater reliance upon the projections out to 2060. While confidence levels around ice projections in 2060 and those for 2100 are not significantly different, the Science Team generally felt that there was much less confidence in predicting the behavioral responses of Pacific walruses under increasing environmental stressors out to 2100 given the ability of Pacific walruses to change their behavior and/or adapt to environmental stressors in the intervening eighty years. Specifically, the intermediate nodes in the Bayesian Belief Network (BBN) model, which were solicited without consideration of a timeframe, indicate that the Science Team members have significant concern over the ability of walruses to breed in the winter and particularly to nurse and provide post-natal care in the spring if these life history events were to occur in the absence of sea ice. Conversely, the Science Team expressed significant uncertainty as to how the impact of the other nodes in the BBN model (e.g. human settlements, climate change on benthos) would change through time and how the ability of walruses to modify their behavior and/or adapt to those changing conditions would influence walrus responses out to 2100. The Science Team therefore postulated that while the predicted changes in sea ice are linear and incremental , that Pacific walruses could make corresponding changes in behavior over the approximately 80 years between today and the 2100 projections. The ability of walruses to change their behavioral responses led the Science Team to express significant uncertainty in their current ability to confidently predict walrus responses out to the end of century.

As stated above, the Science Team expressed great uncertainty as to how walruses would respond to significantly changing ice conditions and the subsequent consequences for reproduction and survival. Changes in the timing of migration, amount of time spent on land, and time spent swimming to access foraging grounds are some of the changes in the Pacific walrus's behavior that have already been observed. The Science Team, and the participants in the Traditional Ecological Knowledge Workshop, stated that they expect Pacific walruses to continue to adapt to these changes in their environment and this contributed to the increased uncertainly in the Science Team's ability to predict walrus's behavioral response, particularly at the end of century. Their lack of confidence is based, in part, in their acknowledgement that some of the predictions they made at the time of the 2011 listing determination have not played out in the past six years as they had expected. For example, the Science Team had predicted that the probability of stampedes, and associated mortality, would increase as use of land haulouts increased. While they acknowledge that the risk remains, they note that the locally based stewardship of these sites both in the U.S. and the Russian Federation has been successful in limiting disturbance and associated mortality in recent years. The Science Team had also predicted that the number of Pacific walruses hunted was based on community needs and therefore would remain at a relatively constant level into the future. In the past few years the

level of harvest has declined, primarily due to poor weather and sea ice conditions as well as a shortening of the timing of migration all of which have negatively impacted the ability of subsistence hunters to access the resource. Furthermore, subsistence hunters report that rapidly changing environmental conditions and their historic patterns of timing of harvests no longer apply and today hunters have to be more flexible and opportunistic across many different species important for subsistence.

It is indisputable that walruses will need to change their behavior during the summer and fall as the number of ice free months increases from two in the current time period to five months in 2060 and 2100. The SSA is clear that these changes will result in negative impacts to walruses due to a combination of factors including the risk of stampedes and longer swimming times to access suitable feeding grounds. The energetic costs of greater swimming distance are supported by recent work undertaken by the U.S. Geological Survey (USGS) who provided preliminary findings to the Science Team for their consideration which are supported in a recent peer reviewed scientific publication. Under RCP 8.5, modeling projections out to 2100 also result in ice free months in the spring and the winter. It is indisputable that walruses will need to additionally change their behavior in response to these ice changes given the strong association of winter breeding with ice and spring birthing and nursing with ice. It is also likely that these changes will have negative consequences for Pacific walruses. So, the information in the SSA, and the stated best professional judgment of the Science Team, is that Pacific walruses will have to change their behavior in response to the predicted reduction in sea ice availability and these changes will, on balance, have negative impacts on the reproduction and survival of the population. It is the best professional judgment of the Science Team that the magnitude of these negative impacts are highly uncertain and speculative, particularly at end of century.

It is clear that ice conditions have and will continue to change and that as a result of those changes Pacific walruses will have to change how they utilize ice and land environments. These changes are likely to have negative consequences for reproduction and survival. While I remain convinced and concerned that Pacific walruses are likely to be negatively impacted by sea ice changes, I find it compelling that the best professional judgment of the Science Team is that predicting the magnitude of the negative impacts that would be realized eighty years from now is speculative and therefore unreliable. As a result, it seems reasonable and appropriate to constrain the foreseeable future to the time period and conditions in which the Science Team advises that predictions about walrus's behavioral response are more reliable and therefore, the consequences for resilience, representation and redundancy are also reliable. This means that the most appropriate foreseeable future for the Pacific walrus ESA listing determination is 2060.

The four members of the Decision Team evaluated predicted conditions for Pacific walrus at 2060 under RCP 4.5 and 8.5. Compared to 2015, under RCP 4.5 there is an 8 percent reduction in ice during the spring, 12 percent increase in the winter and a 70 percent decrease in the summer/fall. There is an approximately 60 percent probability of low abundance stressors and 40 percent probability of high stressors at 2060 under RCP 4.5. Compared to 2015, under RCP 8.5 there is a 13 percent reduction in ice during the spring, a 2 percent reduction in the winter, and an 85 percent reduction in the summer/fall. There is an about an even 50:50 split between the probability of low and high abundance stressors at 2060 under RCP 8.5. Under current

conditions, the Science Team estimated an 80 percent probability of low abundance stressors and 20 percent probability of high abundance stressors acting upon the population.

In considering the above predictions, the Decision Team expressed concern over the significant loss of sea ice habitat during the summer/fall period as well as the increase in the probability of high stressors. We noted, however, that the Science Team did not identify any critical life history activities occurring in the summer/fall period that were ice dependent behaviors. Breeding occurs in the winter time period and birthing and post-natal care occurs in the spring time period, all of which appear to be ice dependent activities. It is important to note that under both RCP 4.5 and RCP 8.5, less than 50 percent of the models projected any one month as ice free across the years in these critical time periods out to 2100 and 2060 respectively. While nursing occurs during the summer/fall it is not entirely ice dependent. While we expect the reduction in ice availability in the summer/fall to have negative consequences for survival and recruitment, we expect these activities to still be able to be carried out. A logical consequence of decreased survival and recruitment would be a reduction in the overall population size, from the newest estimate of 283,213 individuals. At 2060, under the worst case scenario of RCP 8.5, the population would be expected to be experiencing moderate levels of stress, as illustrated by the results of the BBN outcome of a 50:50 split between the probability of low and high abundance stressors. A population predicted to experience these conditions in the foreseeable future would not, in my view, now meet the definition of a threatened species (i.e. likely to become an endangered species).

Other Considerations

The estimated generation time for Pacific walruses is about 15 years. Consideration of generation time is relevant when determining the foreseeable future for a species. The 43 year timeframe we have determined to be reliable for predictions of the behavioral responses of Pacific walruses, and the resulting consequences for reproduction and survival under significantly different environmental conditions corresponds closely to the timeframe of three Pacific walrus generations (45 years). Three generations was considered an appropriate timespan to reliably assess the status of polar bears and other species and the effects of threats on population-level parameters. This was based on the life history of the species, the large natural variability associated with population processes, and the capacity of the species for ecological and behavioral adaptation.

The information presented in the SSA indicates that the Pacific walrus population increased from 1950 to 1980 and then subsequently declined from 1980 to the 2000s, with the steepest declines occurring in the1980s. However, this recent population decline moderated in the 2000s and since 2014, the population appears to be approaching stability. An aerial survey conducted in 2006 estimated total population abundance as 129,000 individuals with a 95 percent confidence interval of 55,000 to 507,000 walruses. Analysis of preliminary data available from the ongoing genetic mark recapture work being conducted by the Service results in a total estimated population size in 2014 of 283,213 with a 95 percent confidence interval of 93,000 to 478,975. While these results are preliminary, they provide information that the population may be approximately double the size assumed at the time of our 2011 ESA listing determination.

Consideration of the 2011 Listing Determination

When Pacific walruses were evaluated in 2011, the Status Review document considered 2095 as the foreseeable future based on sea ice modeling. Sea ice modeling projections available in 2011 did not project a loss of sea ice in the winter breeding season or the spring calving season at 2095. Therefore, there was no need to predict or speculate on the ability of Pacific walruses to breed and birth in the absence of sea ice during a portion of these critical periods when the ESA listing determination was made in 2011.

Concern over the foreseeable future of Pacific walrus in 2011 was focused on the loss of sea ice in the summer and fall (ice free months were projected to increase from 1 to 5 months) and associated impacts and subsistence harvest were identified as the primary threats in the foreseeable future. Concern was expressed over the dependence on coastal haulouts and localized prey depletion, increased energetic costs to obtain prey, disturbance and trampling at coastal haulouts, and the adequacy of regulatory mechanisms to prevent subsistence harvest from becoming unsustainable in the foreseeable future. While these were all identified as concerns due to their projected negative impact on the species, the magnitude of the impact and the resulting effect on resilience, representation and redundancy was not identified and articulated. The 2017 SSA discusses these same threats and includes more recent information. Specifically, local protection of coastal haulouts has proven to have been effective in recent years in minimizing disturbance and associated mortality events. Concerns over increased energetic costs to obtain prey were expressed in both 2011 and 2017, the only difference being that additional information is available now that quantifies the increased energetic costs. In 2011 it was assumed that the level of subsistence harvest would remain constant and therefore the rate of harvest would increase as population numbers decreased. Harvest in recent years, however, has declined due to the difficulty in accessing Pacific walruses. Therefore, given the harvest data in recent years, the Science Team did not use the same assumptions used in the 2011 status review. As noted earlier, the estimated population size at the time of the 2011 status review was 129,000 (55,000 to 507,000) whereas the preliminary estimate available now is 283,213 (93,000 to 478,975). While population size alone does not determine whether a species is threatened or endangered, a relatively larger population experiencing a similar level of threats as a smaller population is likely to be more resilient. Furthermore, based on two USGS analyses, we now understand that the population underwent a significant decline from approximately 1980 to 2000 but that the decline has significantly moderated and the population appears to be approaching stability.